AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

Claim 1 (Previously Presented): An optical information recording medium for recording information by a plurality of record mark lengths, wherein the shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, at least a phase change recording layer, wherein erasing of information is made by recrystallization which substantially proceeds by crystal growth from a boundary between a peripheral crystal portion and an amorphous portion or a melt portion and wherein the phase change recording layer is made of a thin film comprising Ge, Sb and Te as main components.

Claim 2-3 (Cancelled).

Claim 4 (Previously Presented): An optical information recording medium for recording information by a plurality of record mark lengths, wherein the shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, a phase change recording layer which is made of a thin film comprising Ge, Sb and Te as main components, wherein said medium will be crystallized when the recording layer is continuously irradiated at a constant linear velocity with a recording laser beam having a writing power Pw sufficient to melt the recording layer, and an amorphous mark will be formed when the recording layer is irradiated at a constant linear velocity with a recording laser beam having a writing power Pw sufficient to melt the recording layer, and then the recording laser beam is cut off, and wherein when recording of signals is carried out by a plurality of record mark lengths of which the shortest mark length is at most 0.5μm, the recording is made under the following condition:

$M_1/M_0 \geq 0.9$

wherein M_0 represents a modulation of signals retrieved immediately after the recording, and M_1 represents a modulation of signals retrieved after the recording medium is kept for 1,000 hours under a condition of 80°C and 80% relative humidity after the recording.

Claim 5 (Cancelled).

Claim 6 (Previously Presented): The optical information recording medium according to any one of Claims 1 or 4, wherein when recording of random signals of EFM plus modulation system is carried out by a plurality of record mark lengths of which the shortest mark length is at most 0.4μm, the recording is made under the following condition:

$M_1/M_0 \geq 0.9$

wherein M_0 represents a modulation of signals retrieved immediately after the recording, and M_1 represents a modulation of signals retrieved after the recording medium is kept for 1,000 hours under a condition of 80°C and 80% relative humidity after the recording.

Claim 7 (Previously Presented): An optical information recording medium for recording information by a plurality of record mark lengths, which comprises a substrate, and a first protective layer, a phase change recording layer, a second protective layer and a reflective layer, formed on the substrate sequentially from the incident direction of a recording or retrieving laser beam, wherein the shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, wherein the phase change recording layer is made of a thin film having a thickness of from 5nm to 25nm and comprising, as a main component, a GeSbTe alloy having a composition represented by a region (except for the boundary lines) defined by four linear lines, i.e. linear

line A connecting ($Sb_{0.7}Te_{0.3}$) and Ge, linear line B connecting ($Ge_{0.03}Sb_{0.68}Te_{0.29}$) and ($Sb_{0.95}Ge_{0.05}$), linear line C connecting ($Sb_{0.9}Ge_{0.1}$) and ($Te_{0.9}Ge_{0.1}$) and linear line D connecting ($Sb_{0.8}Te_{0.2}$) and Ge, in the GeSbTe ternary phase diagram, and the second protective layer has a thickness of from 5nm to 30nm and wherein the reflective layer has a thickness of from 40nm to 300nm and a volume resistivity of from 20nΩ·m to 150nΩ·m.

Claim 8 (Original): The optical information medium according to Claim 7, wherein the recording layer is made of a thin film comprising, as a main component, a GeSbTe alloy having a composition represented by a region (except for the boundary lines) defined by four linear lines, i.e. linear line A connecting ($Sb_{0.7}Te_{0.3}$) and Ge, linear line B' connecting ($Ge_{0.03}Sb_{0.68}Te_{0.29}$) and ($Sb_{0.9}Ge_{0.1}$) , linear line C connecting ($Sb_{0.9}Ge_{0.1}$) and ($Te_{0.9}Ge_{0.1}$) and linear line D connecting ($Sb_{0.8}Te_{0.2}$) and Ge, in the GeSbTe ternary phase diagram.

Claim 9 (Original): The optical information recording medium according to Claim 7, wherein the recording layer is made of a thin film comprising, as a main component, a $Ge_x(Sb_yTe_{1-y})_{1-x}$ alloy, wherein $0.04 \leq x < 0.10$ and $0.72 \leq y < 0.8$.

Claim 10 (Original): The optical information recording medium according to Claim 7, wherein the recording layer is made of a thin film comprising, as a main component, a $Ge_x(Sb_yTe_{1-y})_{1-x}$ alloy, wherein $0.045 \leq x \leq 0.075$ and $0.74 \leq y < 0.8$.

Claim 11 (Original): The optical information recording medium according to any one of Claims 7 to 10, wherein the recording layer further contains at least one element selected from the group consisting of O, N and S, and the total content of such elements is from 0.1 atomic % to 5 atomic %.

Claim 12 (Original): The optical information recording medium according to any one of Claims 7 to 10, wherein the recording layer further contains at least one element selected from the group consisting of V, Nb, Ta, Cr, Co, Pt and Zr, and the total content of such elements is at most 8 atomic %, and the total content of such elements and Ge is at most 15 atomic %.

Claim 13 (Original): The optical information recording medium according to any one of Claims 7 to 10, wherein the recording layer further contains at least one element selected from the group consisting of Al, In and Ga, and the total content of such elements is at most 8 atomic %, and the total content of such elements and Ge is at most 15 atomic %.

Claim 14 (Previously Presented): The optical information recording medium according to any one of Claims 7 to 10, wherein the recording layer has a thickness of from 10nm to 20nm.

Claim 15 (Previously Presented): The optical information recording medium according to any one of Claims 7 to 10, wherein the second protective layer has a thickness of from 10nm to 25nm.

Claim 16 (Previously Presented): The optical information recording medium according to any one of Claims 7 to 10, which is a medium for recording or retrieving information by applying a recording or retrieving laser beam through the substrate, and wherein the first protective layer has a thickness of at least 50nm.

Claim 17 (Cancelled).

Claim 18 (Previously Presented): The optical information recording medium according to Claim 7, wherein the reflective layer has a thickness of from 150nm to 300nm and is made of an Al alloy containing from 0.2 atomic % to 2 atomic % of at least one member selected from the group consisting of Ta, Ti, Co, Cr, Si, Sc, Hf, Pd, Pt, Mg, Zr, Mo and Mn.

Claim 19 (Previously Presented): The optical information recording medium according to Claim 7, wherein the reflective layer has a thickness of from 40nm to 150nm and is made of a Ag alloy containing from 0.2 atomic % to 5 atomic % of at least one member selected from the group consisting of Ti, V, Ta, Nb, W, Co, Cr, Si, Ge, Sn, Sc, Hf, Pd, Rh, Au, Pt, Mg, Zr, Mo and Mn.

Claim 20 (Previously Presented): The optical information recording medium according to any one of Claims 7 to 10, wherein the reflective layer is a multilayer reflective layer made of a plurality of metal films and at least 50% of the total thickness of the multilayer reflective layer has a volume resistivity of from 20nΩ·m to 150nΩ·m.

Claim 21 (Previously Presented): The optical information recording medium according to any one of Claims 7, 18 or 19, wherein an interfacial layer having a thickness of from 5nm to 100nm is formed between the second protective layer and the reflective layer.

Claim 22 (Previously Presented): The optical information recording medium according to Claim 7, wherein an interfacial layer having a thickness of from 1nm to 100nm is formed between the second protective layer and the reflective layer, the interfacial layer is made of an Al alloy containing from 0.2 atomic % to 2 atomic % of at least one member

selected from the group consisting of Ta, Ti, Co, Cr, Si, Sc, Hf, Pd, Pt, Mg, Zr, Mo and Mn, and the reflective layer is made of Ag or a Ag alloy containing from 0.2 atomic % to 5 atomic % of at least one member selected from the group consisting of Ti, V, Ta, Nb, W, Co, Cr, Si, Ge, Sn, Sc, Hf, Pd, Rh, Au, Pt, Mg, Zr, Mo and Mn.

Claim 23 (Original): The optical information recording medium according to Claim 22, wherein a layer made of an oxide of the above Al alloy and/or Ag alloy, is present between the interfacial layer and the reflective layer, and the thickness of the oxide layer is from 1nm to 10nm.

Claim 24 (Previously Presented): The optical information recording medium according to any one of Claims 7-10 or 18-19, wherein the substrate has a groove for recording the information, with a pitch of at most 0.8μm.

Claim 25 (Original): The optical information recording medium according to Claim 24, which is a medium for recording data only in the groove, wherein the depth of the groove is within a range of from $\lambda/(20n)$ to $\lambda/(10n)$, where λ is the wavelength of the retrieving laser beam, and n is the refractive index of the substrate at the wavelength.

Claim 26 (Original): The optical information recording medium according to Claim 25, which is a medium for recording or retrieving data by focusing a laser beam having a wavelength of from 630 to 670nm on the recording layer through the substrate by an object lens having a numerical aperture NA of from 0.6 to 0.65, wherein the groove has a groove pitch of from 0.6 to 0.8μm, a groove depth of from 25 to 40nm and a groove width of from 0.25 to 0.5μm, and the groove is wobbling with a period which is from 30 to 40 times the

reference clock period T of data, the amplitude of the wobbling (peak-to-peak) being from 40 to 80nm.

Claim 27 (Original): The optical information recording medium according to Claim 24, which is a medium for recording data both in the groove and on the land, wherein the groove is present on the substrate, the depth of the groove is from $\lambda/(7n)$ to $\lambda / (5n)$ or from $\lambda / (3.5n)$ to $\lambda / (2.5n)$, where λ is the wavelength of the retrieving laser beam, and n is the refractive index of the substrate at the wavelength, both the groove width GW and the land width LW are from 0.2μm to 0.4μm, and the ratio of GW/LW is from 0.8 to 1.2.

Claim 28 (Original): The optical information recording medium according to any one of Claims 1, 4 and 7, wherein a recording laser beam having an erasing power Pe capable of crystallizing amorphous phase is applied between record marks, and

when the time length of one record mark is represented by nT (wherein T is the reference clock period, and n is an integer of at least 2), the time length nT of the record mark is divided in the order of:

$\eta_1 T, \alpha_1 T, \beta_1 T, \alpha_2 T, \beta_2 T, \ldots,$

$\alpha_i T, \beta_i T, \ldots, \alpha_m T, \beta_m T, \eta_2 T$

wherein m is a pulse dividing number, and m=n-k, where k is an integer of $0 \leq k \leq 2$,

$\Sigma_i (\alpha_i + \beta_i) + \eta_1 + \eta_2 = n$, η_1 is a real number of $\eta_1 \geq 0$, η_2 is a real number of $\eta_2 \geq 0$, provided $0 \leq \eta_1 + \eta_2 \leq 2.0$,

$\alpha_i (1 \leq i \leq m)$ is a real number of $\alpha_i > 0$, $\beta_i (1 \leq i \leq m)$ is a real number of $\beta_i > 0$, $\Sigma\alpha_i < 0.5n$,

$\alpha_1 = 0.1$ to 1.5, $\beta_1 = 0.3$ to 1.0, $\beta_m = 0$ to 1.5, $\alpha_i = 0.1$ to 0.8 $(2 \leq i \leq m)$, and

when i is $3 \leq i \leq m$, $\alpha_i + \beta_{i-1}$ is within a range of from 0.5 to 1.5 and is constant irrespective of i,

a recording laser beam having a writing power Pw of $Pw \geq Pe$, sufficient to melt the recording layer, is applied within the time of $\alpha_i T$ $(1 \leq i \leq m)$, and a recording laser beam having a bias power Pb of $0 < Pb \leq 0.2Pe$ is applied within the time of $\beta_i T(1 \leq i \leq m)$ (provided that within $\beta_m T$, the bias power may be $0 < Pb \leq Pe$).

Claim 29 (Original): The optical information recording medium according to Claim 28, whereby when recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 350 to 680nm on the recording layer through an object lens having a numerical aperture of from 0.55 to 0.9, the recording is carried out under the following conditions:

$m = n-1$ or $m = n-2$,

$\alpha_1 = 0.3$ to 1.5,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.8 $(2 \leq i \leq m)$,

$\alpha_i + \beta_{i-1} = 1.0$ $(3 \leq i \leq m)$,

$0 \leq Pb \leq 1.5$ (mW),

$0.3 \leq Pe/Pw \leq 0.6$.

Claim 30 (Currently Amended): The optical information recording medium according to Claim 28 ~~or 29~~, whereby when recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 600 to 680nm on the recording layer through the substrate by an object lens having a numerical aperture of from 0.55 to 0.65, with the shortest mark length being within a range of from 0.35 to 0.45μm, the recording is carried out under the following conditions:

n is an integer of from 1 to 14,

$m = n-1$,

Pb is constant irrespective of the linear velocity,

Pe/Pw is changeable depending upon the linear velocity within a range of from 0.4 to 0.6,

(i) within a linear velocity of from 3 to 4 m/s, the reference clock period T is To,

$\alpha_i = 0.3$ to 0.8,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.4 and is constant irrespective of i $(2 \leq i \leq m)$,

$\alpha_2 + \beta_1 \geq 1.0$,

$\alpha_i + \beta_{i-1} = 1.0$ $(3 \leq i \leq m)$,

$\beta_m = 0.3$ to 1.5, and

a recording laser beam having a writing power Pw1 is irradiated within the time of $\alpha_i T$ $(1 \leq i \leq m)$,

(ii) within a linear velocity of from 6 to 8 m/s,

the reference clock period T is To/2,

$\alpha'_1 = 0.3$ to 0.8,

$\alpha'_1 \geq \alpha'_i = 0.3$ to 0.5 and is constant irrespective of i $(2 \leq i \leq m)$,

$\alpha'_i + \beta'_{i-1} = 1.0$ $(3 \leq i \leq m)$,

$\beta'_m = 0$ to 1.0, and

a recording laser beam having a writing power Pw2 is irradiated within the time of $\alpha_i T$ $(1 \leq i \leq m)$,

wherein $\alpha'_1 > \alpha_i (2 \leq i \leq m)$, and $0.8 \leq Pwl/Pw2 \leq 1.2$.

Claim 31 (Original): The optical information recording medium according to Claim 28, having a predetermined record region, whereby recording is carried out by rotating the medium at a constant angular velocity so that the linear velocity at the inner-most diameter of the record region will be from 2 to 4m/s, and the linear velocity at the outer-most diameter of the record region will be from 6 to 10m/s, wherein the record region comprises a plurality of radially divided zones, and when recording is carried out by changing the reference clock period T so that the recording density becomes substantially constant depending upon the average linear velocity within each zone, m is made constant irrespective of the zone, and Pb/Pe and/or α_i (where i is at least one of $1 \leq i \leq m$) is simply decreased from the outer zone towards the inner zone.

Claim 32 (Original): The optical information recording medium according to Claim 31, wherein the record region is radially divided into p zones, and when the inner-most diameter side is referred to as the first zone, the outer-most diameter side is referred to as the p-th zone, and in the q-th zone (wherein q is an integer of $1 \leq q \leq p$) , the angular velocity is represented by ω_q, the average linear velocity is represented by $<V_q>_{ave}$, the maximum linear velocity is represented by $<V_q>_{max}$, the minimum linear velocity is represented by $<V_q>_{min}$, the reference clock period is represented by T_q, and the time length of the shortest mark is represented by $n_{min}T_q$,

$<V_p>_{ave}/<V_1>_{ave}$ is within a range of from 1.2 to 3, and $<V_q>_{max}/<V_q>_{min}$ is at most 1.5,

(i) within the same zone, ω_q, T_q, α_i, β_i, Pe, Pb and Pw are constant, the physical length $n_{min}T_q<V_q>_{ave}$ of the shortest mark is at most 0.5 μm, $T_q<V_q>_{ave}$ is substantially constant with respect to all q of $1 \leq q \leq p$, and

m = n-1 or m = n-2,

$\alpha_1 = 0.3$ to 1.5,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.8 ($2 \leq i \leq m$),

$\alpha_i + \beta_{i-1} = 1.0$ ($3 \leq i \leq m$),

$0 \leq Pb \leq 1.5$ (mW),

$0.4 \leq Pe/Pw \leq 0.6$, and

(ii) for every zone, Pb, Pw, Pe/Pw, α_i($1 \leq i \leq m$), β_i and β_m are variable, and recording is carried out by simply decreasing at least α_i (i is at least one of $2 \leq i \leq m$) from the outer zone towards the inner zone.

Claim 33 (Original): The optical information recording medium according to Claim 32, wherein $Pw_{max}/Pw_{min} \leq 1.2$, where Pw_{max} is the maximum value and Pw_{min} is the minimum value of Pw in the record region.

Claim 34 (Currently Amended): The optical information recording medium according to ~~any one of Claims~~ Claim 31 ~~to 33~~, whereby when recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 600 to 680nm on the recording layer through the substrate by an object lens having a numerical aperture NA of from 0.55 to 0.65, the recording is carried out under the following conditions:

the inner-most diameter of the record region is within a range of the radius being from 20 to 25mm, the radius of the outer-most diameter is within a range of from 55 to 60mm, and the average linear velocity in the inner-most diameter zone is from 3 to 4m/s,

when in the q-th zone (wherein q is an integer of $1 \leq q \leq p$), the angular velocity is represented by ω_q, the average linear velocity is represented by $<V_q>_{ave}$, the maximum linear velocity is represented by $<V_q>_{max}$, the minimum linear velocity is represented by $<V_q>_{min}$,

the reference clock period is represented by T_q, and the time length of the shortest mark is represented by $n_{min}T_q$,

n is an integer of from 1 to 14,

$m = n-1$,

ω_q, Pb and Pe/Pw are constant irrespective of the zone,

$Tq<V_q>_{ave}$ is substantially constant with respect to all q of $1 \leq q \leq p$, and

$(<V_q>_{max}-<V_q>_{min}) / (<V_q>_{max}+<V_q>_{min}) <10\%$,

(i) in the first zone,

$\alpha^1_1 = 0.3$ to 0.8,

$\alpha^1_1 \geq \alpha^1_i = 0.2$ to 0.4 and is constant irrespective of i $(2 \leq i \leq m)$,

$\alpha^1_2 + \beta^1_1 \geq 1.0$,

$\alpha^1_i + \beta^1_{i-1} = 1.0$ $(3 \leq i \leq m)$,

(ii) in the p-th zone,

$\alpha^P_1 = 0.3$ to 0.8,

$\alpha^P_1 \geq \alpha^P_i = 0.3$ to 0.5 and is constant irrespective of i $(2 \leq i \leq m)$,

$\alpha^P_i + \beta^P_{i-1} = 1.0$ $(2 \leq i \leq m)$, and

(iii) in other zones, $\alpha^1_i \leq \alpha^q_i \leq \alpha^P_i$ $(2 \leq i \leq m)$, and α^q_1 is a value between α^1_1 and α^P_1.

Claim 35 (Original): The optical information recording medium according to Claim 34, wherein recording is carried out by adjusting $\alpha^1_1 \geq \alpha^q_1 \geq \alpha^P_1$ (provided $\alpha^1_1 > \alpha^P_1$).

Claim 36 (Currently Amended): The optical information recording medium according to Claim 34 ~~or 35~~, wherein Pb, Pe/Pw, β_1 and β_m are constant irrespective of the zone, and recording is carried out by changing α_1 and α_i $(2 \leq i \leq m)$ depending on the zone.

Claim 37 (Currently Amended): The optical information recording medium according to ~~any one of Claims~~ Claim 34 ~~to 36~~, wherein numerical values for at least Pe/Pw, Pb, Pw, β_m, (α^1_1, α^P_1), (α^1_c, α^P_c) are preliminarily recorded on the substrate by prepits or groove deformation.

Claim 38 (Currently Amended): The optical information recording medium according to ~~any one of Claims~~ Claim 34 ~~to 37~~, which is an optical information recording medium having an address information preliminarily recorded on the substrate by prepits or groove deformation, wherein the address includes, together with the address information, an information relating to suitable α_1 and α_i ($2 \leq i \leq m$).

Claim 39 (Original): The optical information recording medium according to any one of Claims 1, 4 and 7, wherein a recording laser beam having an erasing power Pe capable of crystallizing amorphous phase is applied between record marks, and

when the time length of one record mark is represented by nT (wherein T is the reference clock period, and n is an integer of at least 2), the time length nT of the record mark is divided in the order of:

η_1T, α_1T, β_1T, α_2T, β_2T, ... ,

α_iT, β_iT, ... , α_mT, β_mT, η_2T

wherein m is a pulse dividing number, and m=n-k, where k is an integer of $0 \leq k \leq 2$,

$\Sigma_i (\alpha_i + \beta_i) + \eta_1 + \eta_2 = n$, η_1 is a real number of $\eta_1 \geq 0$, η_2 i s a real number of $\eta_2 \geq 0$, provided $0 \leq \eta_1 + \eta_2 \leq 2.0$,

$\alpha_i (1 \leq i \leq m)$ is a real number of $\alpha_i > 0$, $\beta_i (1 \leq i \leq m)$ is a real number of $\beta_i > 0$,

$\alpha_1 = 0.1$ to 1.5, $\beta_1 = 0.3$ to 1.0, $\beta_m = 0$ to 1.5, and when i is $2 \leq i \leq m$, α_i is within a range of from 0.1 to 0.8 and is constant irrespective of i, and

when i is $3 \leq i \leq m$, $\alpha_i + \beta_{i-1}$ is within a range of from 0.5 to 1.5 and is constant irrespective of i,

a recording laser beam having a writing power Pw of Pw > Pe, sufficient to melt the recording layer, is applied within the time of $\alpha_i T$ ($1 \leq i \leq m$), and a recording laser beam having a bias power Pb of $0 < Pb \leq 0.2Pe$ is applied within the time of $\beta_i T$ ($1 \leq i \leq m$) (provided that within $\beta_m T$, the bias power may be $0 < Pb \leq Pe$), and

while maintaining m, $\alpha_i + \beta_{i-1}$($3 \leq i \leq m$), $\alpha_1 T$ and $\alpha_i T$ ($2 \leq i \leq m$) to be constant irrespective of the linear velocity, β_m is changed so that it simply increases as the linear velocity is small.

Claim 40 (Original): The optical information recording medium according to Claim 39 for recording under the following conditions:

$Pw_{max}/Pw_{min} \leq 1.2$,

$Pe/Pw = 0.4$ to 0.6,

$0 \leq Pb \leq 1.5$ (mW)

where Pw_{max} is the maximum recording power and Pw_{min} is the minimum recording power, at each recording linear velocity.

Claim 41 (Original): The optical information recording medium according to Claim 40 for recording under a condition of $\Sigma\alpha_i < 0.5n$ at a recording linear velocity of at most 5m/s.

Claim 42 (Currently Amended): The optical information recording medium according to Claim 40 ~~or 41~~ for recording under a condition such that when β_m at the maximum recording linear velocity is represented by $\beta^H{}_m$ and β_m at the minimum recording

linear velocity is represented by $\beta^L{}_m$, β_m at other recording linear velocities is a value between $\beta^L{}_m$ and $\beta^H{}_m$, and Pb and Pe/Pw are constant irrespective of the recording linear velocity.

Claim 43 (Currently Amended): The optical information recording medium according to Claim 39 ~~or 40~~ for recording under a condition such that β_m is constant irrespective of the recording linear velocity.

Claim 44 (Original): The optical information recording medium according to Claim 42, wherein numerical values for at least the Pe/Pw ratio, Pb, Pw, $\alpha_1 T$, $\alpha_i T$ ($2 \leq i \leq m$) and ($\beta^L{}_m$, $\beta^H{}_m$) are preliminarily recorded on the substrate by prepits or groove deformation.

Claim 45 (Original): The optical information recording medium according to any one of Claims 1, 4 and 7, which is an optical information recording medium having a predetermined record region, the record region being divided into p zones having radially equal widths and designed to record information by a plurality of mark lengths, by rotating the medium at a constant angular velocity irrespective of the radial position, wherein on the substrate, a groove having a predetermined groove-wobbling signal, is formed, so that the reference period of the groove-wobbling signal varies for every zone, and when in the q-th zone (provided that q is an integer of $1 \leq q \leq p$), the average linear velocity is represented by $<V_q>_{ave}$, the maximum linear velocity is represented by $<V_q>_{max}$, the minimum linear velocity is represented by $<V_q>_{min}$ and the reference period of the groove-wobbling signal is represented by Tw_q,

$<V_q>_{ave} Tw_q$ is constant, and

$(<V_q>_{max} - <V_q>_{min}) / (<V_q>_{max} + <V_q>_{min}) < 1\%$.

Claim 46 (Original): The optical information recording medium according to Claim 45, wherein one revolution of the above groove is taken as one zone, the groove is wobbling with a constant period irrespective of the zone, and the following relation is approximately satisfied:

$$2\pi \cdot TP = a \cdot Tw_0 \cdot v_0$$

where TP is the groove pitch, Tw_0 is the wobbling period, and a is a natural number.

Claim 47 (Original): The optical information recording medium according to any one of Claims 1, 4 and 7, which is an optical information recording medium having a predetermined record region, the record region being divided into p zones (provided that p is an integer of at least 200) having radially equal widths, and designed to record information by a plurality of mark lengths, by rotating the medium at a constant angular velocity irrespective of the radial position, wherein on the substrate, a groove having a predetermined groove-wobbling signal, is formed, so that the reference period of the groove-wobbling signal varies for every zone, and $\langle V_q \rangle_{ave} Tw_q$ is constant, where $\langle V_q \rangle_{ave}$ is the average linear velocity, and Tw_q is the reference period of the groove-wobbling signal.

Claim 48 (Original): The optical information recording medium according to Claim 47, wherein the inner-most diameter of the above record region is within a range of the radius being from 20 to 25mm, and the outer-most diameter is within a range of the radius being from 55 to 60mm.

Claim 49 (Previously Presented): An optical recording method for an optical information recording medium, which comprises recording information on the optical information recording medium, wherein a shortest mark length is at most 0.5μm, and a

crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, at least a phase change recording layer, wherein erasing of information is made by recrystallization which substantially proceeds by crystal growth from a boundary between a peripheral crystal portion and an amorphous portion or a melt portion, wherein a recording laser beam having an erasing power Pe capable of crystallizing amorphous phase is applied between record marks, and

when the time length of one record mark is represented by nT (wherein T is the reference clock period, and n is an integer of at least 2), the time length nT of the record mark is divided in the order of:

$\eta_1 T$, $\alpha_1 T$, $\beta_1 T$, $\alpha_2 T$, $\beta_2 T$, ... ,

$\alpha_i T$, $\beta_i T$, ... , $\alpha_m T$, $\beta_m T$, $\eta_2 T$

wherein m is a pulse dividing number, and m=n-k, where k is an integer of $0 \leq k \leq 2$,

$\Sigma_i(\alpha_i + \beta_i) + \eta_1 + \eta_2 = n$, η_1 is a real number of $\eta_1 \geq 0$, η_2 is a real number of $\eta_2 \geq 0$, provided $0 \leq \eta_1 + \eta_2 \leq 2.0$,

$\alpha_i (1 \leq i \leq m)$ is a real number of $\alpha_i > 0$, $\beta_i (1 \leq i \leq m)$ is a real number of $\beta_i > 0$, $\Sigma\alpha_i < 0.5n$,

α_1=0.1 to 1.5, β_1=0.3 to 1.0, β_m=0 to 1.5, α_i=0.1 to 0.8 ($2 \leq i \leq m$), and

when i is $3 \leq i \leq m$, $\alpha_i + \beta_{i-1}$ is within a range of from 0.5 to 1.5 and is constant irrespective of i,

a recording laser beam having a writing power Pw of Pw $\geq$Pe, sufficient to melt the recording layer, is applied within the time of $\alpha_i T$ ($1 \leq i \leq m$), and a recording laser beam having a bias power Pb of $0 < Pb \leq 0.2Pe$ is applied within the time of $\beta_i T (1 \leq i \leq m)$ (provided that within $\beta_m T$, the bias power may be $0 < Pb \leq Pe$).

Claim 50 (Original): The optical recording method according to Claim 49, wherein recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 350 to 680nm on the recording layer through an object lens having a numerical aperture NA of from 0.55 to 0.9, and wherein:

$m = n-1$ or $m = n-2$,

$\alpha_1 = 0.3$ to 1.5,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.8 ($2 \leq i \leq m$),

$\alpha_i + \beta_{i-1} = 1.0$ ($3 \leq i \leq m$),

$0 \leq Pb \leq 1.5$ (mW),

$0.3 \leq Pe/Pw \leq 0.6$.

Claim 51 (Previously Presented): The optical recording method according to Claim 49 or 50, wherein recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 600 to 680nm on the recording layer through the substrate by an object lens having a numerical aperture NA of from 0.55 to 0.65, with the shortest mark length being within a range of from 0.35 to 0.45μm, and wherein:

n is an integer of from 1 to 14,

$m = n-1$,

Pb is constant irrespective of the linear velocity,

Pe/Pw is changeable depending upon the linear velocity within a range of from 0.4 to 0.6,

(i) within a linear velocity of from 3 to 4 m/s, the reference clock period T is To,

$\alpha_1 = 0.3$ to 0.8,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.4 and is constant irrespective of i ($2 \leq i \leq m$),

$\alpha_2 + \beta_1 \geq 1.0$,

$\alpha_i + \beta_{i-1} = 1.0$ ($3 \leq i \leq m$),

$\beta_m = 0.3$ to 1.5, and

a recording laser beam having a writing power Pwl is irradiated within the time of $\alpha_i T$ ($1 \leq i \leq m$),

(ii) within a linear velocity of from 6 to 8 m/s, the reference clock period T is To/2,

$\alpha'_1 = 0.3$ to 0.8,

$\alpha'_1 \geq \alpha'_i = 0.3$ to 0.5 and is constant irrespective of i ($2 \leq i \leq m$),

$\alpha'_i + \beta'_{i-1} = 1.0$ ($3 \leq i \leq m$),

$\beta'_m = 0$ to 1.0, and

a recording laser beam having a writing power Pw2 is irradiated within the time of $\alpha_i T$($1 \leq i \leq m$),

wherein $\alpha'_i > \alpha_i$($2 \leq i \leq m$), and $0.8 \leq Pw1/Pw2 \leq 1.2$.

Claim 52 (Original): The optical recording method according to Claim 49, which is a method for recording information by a plurality of mark lengths by rotating the medium having a predetermined record region, at a constant angular velocity, wherein the medium is rotated so that the linear velocity at the inner-most diameter of the record region will be from 2 to 4m/s, and the linear velocity at the outer-most diameter of the record region will be from 6 to 10m/s, wherein the record region comprises a plurality of radially divided zones, and recording is carried out by changing the reference clock period T so that the recording density becomes substantially constant depending upon the average linear velocity within each zone, m is made constant irrespective of the zone, and Pb/Pe and/or α_i (i is at least one of $1 \leq i \leq m$) is simply decreased from the outer zone towards the inner zone.

Claim 53 (Original): The optical recording method according to Claim 52, wherein the record region is radially divided into p zones, and when the inner-most diameter side is referred to as the first zone, the outer-most diameter side is referred to as the p-th zone, and in the q-th zone (wherein q is an integer of $1 \leq q \leq p$), the angular velocity is represented by ω_q, the average linear velocity is represented by $\langle V_q \rangle_{ave}$, the maximum linear velocity is represented by $\langle V_q \rangle_{max}$, the minimum linear velocity is represented by $\langle V_q \rangle_{min}$, the reference clock period is represented by T_q, and the time length of the shortest mark is represented by $n_{min}T_q$,

$\langle V_p \rangle_{ave} / \langle V_1 \rangle_{ave}$ is within a range of from 1.2 to 3, and $\langle V_q \rangle_{max} / \langle V_q \rangle_{min}$ is at most 1.5,

(i) within the same zone, ω_q, T_q, α_i, β_i, Pe, Pb and Pw are constant, the physical length $n_{min}T_q\langle V_q \rangle_{ave}$ of the shortest mark is at most 0.5µm, $T_q\langle V_q \rangle_{ave}$ is substantially constant with respect to all q of $1 \leq q \leq p$, and

$m = n-1$ or $m = n-2$,

$\alpha_1 = 0.3$ to 1.5,

$\alpha_1 \geq \alpha_i = 0.2$ to 0.8 $(2 \leq i \leq m)$,

$\alpha_i + \beta_{i-1} = 1.0$ $(3 \leq i \leq m)$,

$0 \leq Pb \leq 1.5$ (mW),

$0.4 \leq Pe/Pw \leq 0.6$, and

(ii) in each zone, Pb, Pw, Pe/Pw, α_i $(1 \leq i \leq m)$, β_1 and β_m are variable, and at least α_i (i is at least one of $2 \leq i \leq m$) simply decreases from the outer zone towards the inner zone.

Claim 54 (Original): The optical recording method according to Claim 53, wherein $Pw_{max}/Pw_{min} \leq 1.2$, where Pw_{max} is the maximum value and Pw_{min} is the minimum value of Pw in the record region.

Claim 55 (Previously Presented): The optical recording method according to any one of Claims 52 to 54, wherein recording or retrieving of data is carried out by focusing a laser beam having a wavelength of from 600 to 680nm on the recording layer through the substrate by an object lens having a numerical aperture NA of from 0.55 to 0.65, and wherein

the inner-most diameter of the record region is within a range of the radius being from 20 to 25 mm, the radius of the outer-most diameter is within a range of from 55 to 60mm, and the average linear velocity in the inner-most diameter zone is from 3 to 4m/s,

when in the q-th zone (wherein q is an integer of $1 \leq q \leq p$), the angular velocity is represented by ω_q, the average linear velocity is represented by $<V_q>_{ave}$, the maximum linear velocity is represented by $<V_q>_{max}$, the minimum linear velocity is represented by $<V_q>_{min}$, the reference clock period is represented by T_q, and the time length of the shortest mark is represented by $n_{min}T_q$,

n is an integer of from 1 to 14,

$m = n-1$,

ω_q, Pb and Pe/Pw are constant irrespective of the zone,

$Tq<V_q>_{ave}$ is substantially constant with respect to all q of $1 \leq q \leq p$, and

$(<V_q>_{max}-<V_q>_{min}) / (<V_q>_{max}+<V_q>_{min}) < 10\ \%$,

(i) in the first zone,

$\alpha^1_1 \geq 0.3$ to 0.8,

$\alpha^1_1 \geq \alpha^1_i = 0.2$ to 0.4 and is constant irrespective of i ($2 \leq i \leq m$)

$\alpha^1_2 + \beta^1_1 \geq 1.0$,

$\alpha^1_i + \beta^1_{i-1} = 1.0$ ($3 \leq i \leq m$),

(ii) in the p-th zone,

$\alpha^p_1 = 0.3$ to 0.8,

$\alpha^p_1 \geq \alpha^p_i = 0.3$ to 0.5 and is constant irrespective of i ($2 \leq i \leq m$),

$\alpha^p{}_i + \beta^p{}_{i-1} \geq 1.0$ ($2 \leq i \leq m$), and

(iii) in other zones, $\alpha^1{}_i \leq \alpha^q{}_i \leq \alpha^p{}_i$ ($2 \leq i \leq m$), and

$\alpha^q{}_1$ is a value between $\alpha^1{}_1$ and $\alpha^p{}_1$.

Claim 56 (Original): The optical recording method according to Claim 55, wherein $\alpha^1{}_1 \geq \alpha^q{}_1 \geq \alpha^p$ (provided $\alpha^1{}_1 > \alpha^p{}_1$).

Claim 57 (Currently Amended): The optical recording method according to Claim 55 ~~or 56~~, wherein Pb, Pe/Pw, β_1, and β_m are constant irrespective of the zone, and only α_1 and α_i ($2 \leq i \leq m$) are changed depending upon the zone.

Claim 58 (Previously Presented): An optical recording method for an optical information recording medium, which comprises recording information on the optical information recording medium, wherein a shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, at least a phase change recording layer, wherein erasing of information is made by recrystallization which substantially proceeds by crystal growth from a boundary between a peripheral crystal portion and an amorphous portion or a melt portion, wherein a recording laser beam having an erasing power Pe capable of crystallizing amorphous phase is applied between record marks, and

when the time length of one record mark is represented by nT (wherein T is the reference clock period, and n is an integer of at least 2), the time length nT of the record mark is divided in the order of:

$\eta_1 T, \alpha_1 T, \beta_1 T, \alpha_2 T, \beta_2 T, \ldots,$

$\alpha_i T, \beta_i T, \ldots, \alpha_m T, \beta_m T, \eta_2 T$

wherein m is a pulse dividing number, and m=n-k, where k is an integer of $0 \leq k \leq 2$,

$\Sigma_i (\alpha_i + \beta_i) + \eta_1 + \eta_2 = n$, η_1 is a real number of $\eta_1 \geq 0$, η_2 is a real number of $\eta_2 \geq 2.0$, provided $0 \leq \eta_1 + \eta_2 \leq 2.0$,

$\alpha_i (1 \leq i \leq m)$ is a real number of $\alpha_i > 0$, $\beta_i (1 \leq i \leq m)$ is a real number of $\beta_i > 0$,

$\alpha_1 = 0.1$ to 1.5, $\beta_1 = 0.3$ to 1.0, $\beta_m = 0$ to 1.5, and when i is $2 \leq i \leq m$, α_i is within a range of from 0.1 to 0.8 and is constant irrespective of i, and

when i is $3 \leq i \leq m$, $\alpha_i + \beta_{i-1}$ is within a range of from 0.5 to 1.5 and is constant irrespective of i,

a recording laser beam having a writing power Pw of Pw > Pe, sufficient to melt the recording layer, is applied within the time of $\alpha_i T$ $(1 \leq i \leq m)$, and a recording laser beam having a bias power Pb of $0 < Pb \leq 0.2Pe$ is applied within the time of $\beta_i T (1 \leq i \leq m)$ (provided that within $\beta_m T$, the bias power may be $0 < Pb \leq Pe$), and

while maintaining m, $\alpha_i + \beta_{i-1}$ $(3 \leq i \leq m)$, $\alpha_1 T$ and $\alpha_i T$ $(2 \leq i \leq m)$ to be constant irrespective of the linear velocity, β_m is changed so that it simply increases as the linear velocity is small.

Claim 59 (Original): The optical recording method according to Claim 58 for recording under the following conditions:

$Pw_{max}/Pw_{min} \leq 1.2$,

$Pe/Pw = 0.4$ to 0.6,

$0 \leq Pb \leq 1.5$ (mW)

where Pw_{max} is the maximum recording power and Pw_{min} is the minimum recording power, at each recording linear velocity.

Claim 60 (Original): The optical recording method according to Claim 59 for recording under a condition of $\Sigma\alpha_i < 0.5n$ at a recording linear velocity of at most 5m/s.

Claim 61 (Original): The optical recording method according to Claim 59 for recording under a condition such that when β_m at the maximum recording linear velocity is represented by $\beta^H{}_m$ and β_m at the minimum recording linear velocity is represented by $\beta^L{}_m$, β_m at other recording linear velocities is a value between $\beta^L{}_m$ and $\beta^H{}_m$, and Pb and the Pe/Pw ratio are constant irrespective of the recording linear velocity.

Claim 62 (Original): The optical recording method according to any one of Claims 58 to 60 for recording under a condition such that β_m is constant irrespective of the recording linear velocity.

Claim 63 (Currently Amended): The optical recording method according to ~~any one of Claims~~ Claim 58 ~~to 62~~, which is a method for recording information by a plurality of mark lengths by rotating an optical information recording medium having a predetermined record region, wherein the record region is divided into a plurality of zones in the radial direction, and within each zone, recording is carried out at a constant linear velocity, the ratio of the recording linear velocity V_{out} at the outer-most diameter zone to the recording linear velocity V_{in} at the inner-most diameter zone, i.e. V_{out}/V_{in}, is from 1.2 to 2, and β_m is changed depending upon the linear velocity in each zone.

Claim 64 (Original): The optical recording method according to Claim 49, which is a method for recording information by a plurality of mark lengths by rotating an optical information recording medium having a predetermined record region, wherein the record

region is divided into a plurality of zones in the radial direction, and in each zone, recording is carried out at a constant linear velocity,

the ratio of the recording linear velocity V_{out} in the outer-most diameter zone to the recording linear velocity V_{in} in the inner-most diameter zone, i.e. V_{out}/V_{in} is from 1.2 to 2,

$\alpha_i = 0.3$ to 0.6 ($2 \leq i \leq m$), and $\beta_m = 0$ to 1.5, and m, $\alpha_i + \beta_{i-1}$ ($3 \leq i \leq m$), $\alpha_1 T$, Pe/Pw and Pb are constant irrespective of the linear velocity, and α_i and/or β_m is changed depending upon the linear velocity.

Claim 65 (Currently Amended): An optical recording method, which comprises recording information on the optical information recording medium as defined in ~~any one of Claims~~ Claim 45 ~~to 48~~, wherein the reference clock period T_q is generated as a multiple or a divisor of the reference period Tw_q of the groove wobbling in each zone.

Claim 66 (Previously Presented): An optical information recording medium for recording information by a plurality of record mark lengths, wherein the shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, at least a phase change recording layer, wherein erasing of information is made by recrystallization which substantially proceeds by crystal growth from a boundary between a peripheral crystal portion and an amorphous portion or a melt portion, and

wherein the phase change recording layer is made of a thin film comprising, as a main component, a $M_y(Sb_xTe_{1-x})_{1-y}$ alloy ($0.6 \leq x \leq 0.9$, $0 < y \leq 0.2$, M is at least one of Ga, Zn, Ge, Sn, In, Si, Cu, Au, Ag, Al, Pd, Pt, Pb, Cr, Co, O, S, Se, Ta, Nb and V).

Claim 67 (Previously Presented): An optical information recording medium for recording information by a plurality of record mark lengths, wherein the shortest mark length is at most 0.5μm, and a crystal state is an unrecorded or erased state and an amorphous state is a recorded state, which has, on a substrate, at least a phase change recording layer, wherein erasing of information is made by recrystallization which substantially proceeds by crystal growth from a boundary between a peripheral crystal portion and an amorphous portion or a melt portion, and

wherein when recording of signals is carried out by a plurality of record mark lengths of which the shortest mark length is at most 0.5μm, the recording is made under the following condition:

$M_1/M_0 \geq 0.9$

wherein M_0 represents a modulation of signals retrieved immediately after the recording, and M_1 represents a modulation of signals retrieved after the recording medium is kept for 1,000 hours under a condition of 80°C and 80% relative humidity after the recording.